

CLAIMS

1. In a learning/thinking machine including a knowledge basis composed of:

means for analyzing collected information and extracting a semantic relation in accordance with a plurality of rules; and

means for storing therein semantic contents as a knowledge structured so as to sufficiently express said semantic contents based on the extracted semantic relation, a learning/thinking machine based on a structured knowledge comprising:

means for generating new information by predetermined inference in response to an inquiry or request such that a knowledge structured based on said semantic relation may have new semantic content and relation;

means for evaluating generated new information;

means for judging sequencing of said evaluated result;

means for determining an optima solution based on a judged result;

an input unit for receiving an inquiry or request from the outside; and

verifying means for verifying said inquiry or request from the outside and said knowledge base, wherein if it is determined by said verifying means that said inquiry or request are completely coincident with said knowledge base, then understanding of such coincidence is transmitted to a central unit and if it is determined that said inquiry or request from

the outside are partly coincident with said knowledge base, then information is generated by predetermined inference such that said knowledge structured based on said semantic relation may have new semantic relation and content.

2. A learning/thinking method comprising:

a knowledge input step for inputting inclusively collected data, information and knowledge;

a knowledge structuring step for analyzing information from said inputted data, information and knowledge, extracting a semantic relation in accordance with a plurality of rules and storing structured knowledge based on said extracted semantic relation;

an information generating step for generating new information by predetermined inference so that said knowledge structured based on said semantic relation has new semantic content and relation;

an evaluation judging step for evaluating said information generated new knowledge by verifying said information generated result and said knowledge base; and

an optimal solution deciding step for storing said evaluated/judged result and new information generated knowledge in said knowledge base to increase a knowledge;

said information generating step comprising:

a relating node retrieving step for retrieving only a unit

in which a relating node is stored;

a relating link retrieving step for retrieving only a unit in which a relating link is stored; and

a step for executing inference by using any of at least analogical reasoning, inductive inference, abduction or association based on retrieved result of said relating node retrieving step or said relating link retrieving step.

3. In a learning/thinking method based on a structured knowledge according to claim 2, a learning/thinking method based on a structured knowledge characterized in that said evaluating and judging step comprises:

a step for evaluating new information generated knowledge item by item with reference to the knowledge that has already been stored in said knowledge base;

a step for determining whether or not said new generated knowledge satisfies an inquiry request, setting said knowledge as a nominated solution if said knowledge satisfies said request and searching and evaluating other results item by item if said knowledge does not satisfy said request;

a step for sequencing said nominated knowledge with reference to said knowledge base; and

a step for extracting/deciding nominated knowledge whose target necessary condition is optimum from sequenced nominated knowledge.

4. In a learning/thinking method based on a structured knowledge according to claim 2, a learning/thinking method based on a structured knowledge characterized in that said knowledge generating step comprises:

a step for determining whether or not new knowledge information generated at said information generating step and which is generated at said evaluating/deciding step as an optimal solution is increased as a new node;

a step for storing said new node in a unit integration memory if it is determined that said new information is increased as said new node;

a step for determining said generated new knowledge is increased as a link regardless of the increase of said node;
and

a step for storing said new link in said unit integration memory if it is determined that said generated new knowledge is increased as said new link.

5. In a computer system in which a central management computer and a plurality of cell computers are coupled so as to communicate with each other, a computer system characterized in that:

said central management computer can store all addresses and names of said plurality of cell computer before it is being

operated, said central management computer can input questions to all of said plurality of computer and said central management computer can output answers to questions;

all of said cell computers stores therein a knowledge structured so as to indicate each knowledge and its connection destination knowledge and all of said cell computers can access information of a connection destination of a semantic relation of each knowledge;

when a question is inputted, said question is transmitted from said central management computer to said plurality of cell computers, as a presupposing operation, said cell computer is changed to a processing target state or an unsuitable state based on connection information of a semantic relation relative to said question of knowledge each of said plurality of cell computers has; and

a cell computer having no semantic relation to said question is placed in the unsuitable state and transmits information indicative of said unsuitable state to said central management computer and said relating cell computer, only the cell computer having a connection of a semantic relation is placed in the processing target state, only said cell computer in said processing target state continues processing, said central management computer analyzes an answer from said cell computer in said processing target state and understands meaning in response to a question to thereby generate new information

and said central management computer converts said generated new information into an output form corresponding to said question and outputs said converted information as an answer.

6. In a computer system according to claim 5, a computer system characterized in that:

said central management computer comprises:

a request condition analyzing unit for analyzing a condition of an inputted question when a question is inputted to said input unit;

a request condition processing target cell detecting unit for transmitting a request condition to all cell computers based on said analyzed request condition, receiving a reply of the unsuitable state from an unsuitable cell computer and detecting a processing target cell computer from all of said cell computers except said unsuitable cell computer in response to said request condition;

a retrieval transmitting and receiving unit for continuing to retrieve only said detected processing target cell computer, receiving a retrieval answer from said processing target cell computer and analyzing a retrieved result based on said received retrieval answer;

a semantic understanding/information generating unit for executing semantic understanding and information generation from said analyzed retrieved result to generate new information;

an output information converting unit for converting generated new information into a requested output form;

a cell connection destination address memory unit for storing therein an address of a connection destination cell computer having a semantic connection based on said generated new information in such a manner that said address can be updated sequentially; and

an answer output unit for outputting said generated new information in the requested output form.

7. In a computer system according to claim 5, a computer system characterized in that:

said plurality of cell computers comprises:

a request condition processing target judging unit for determining by using decision information indicative of the presence or absence of a connection destination cell computer whether or not its own cell computer becomes a processing target in response to the request condition simultaneously transmitted from said central management computer to all cell computers;

an unsuitable replay/connection destination cell communicating unit for returning an information indicative of an unsuitable state to said central management computer if its own cell computer is unsuitable for said request condition and transmitting information indicative of the processing target state to a connection destination cell computer if its own cell

computer becomes a processing target in response to said request condition;

a retrieval receiving unit for receiving retrieval information from said central management computer if its own cell computer becomes the processing target in response to said request condition;

a connection destination judging unit for retrieving other connection destination cell computer which its own cell computer has information connection in response to said request condition and determining by using information of said connection destination cell computer whether or not retrieval based on retrieval information can be executed at every said request condition;

a retrieval answer unit for returning an answer of said executed retrieval to said central management computer;

a knowledge memory unit for storing knowledge obtained based on said retrieval information and said answer of retrieval such that said knowledge can be updated sequentially; and

a connection destination cell memory unit for storing a connection destination cell computer corresponding to said obtained knowledge such that said connection destination cell computer can be updated sequentially.

8. In a computer system according to claim 7, a computer system characterized in that:

said connection destination judging unit comprises:

step number N retrieving means for retrieving a path in which said request condition has a structure of a step number N (natural number);

tree-like path retrieving means for retrieving a path in which said request condition has a tree-like structure; and

loop-like path retrieving means for retrieving a path in which said request condition has a loop-like path to thereby judge a connection corresponding to said request condition structure.

9. In an information generating method using a computer system in which a central management computer and a plurality of cell computers are coupled so as to communicate with each other in which said central management computer stores therein only addresses of said plurality of cell computers before being operated, said central management computer can input a question to said plurality of cell computer and can output an answer to a question;

each of said plurality of cell computers stores therein each knowledge structured in such a manner as to indicate knowledge and knowledge of its connection destination and also stores therein connection destination information of a semantic relation of each knowledge, an information generating method comprises:

a step in which a question is transmitted from said central management computer to all of said plurality of cell computers when a question is inputted;

a step for changing the state into a processing target state or unsuitable state based upon connection information of a semantic relation relative to said question of a knowledge of each of said plurality of cell computers as presupposing operation;

a step in which a cell computer having no connection of a semantic relation to said question is placed in the unsuitable state to return information indicative of the unsuitable state to said central management computer and only a cell computer having a connection of a semantic relation is placed in the processing target state to return an answer to said central management computer;

a step in which said central management computer continues to output a question to only a cell computer in the processing target state; and

a step for generating new information by analyzing and understanding an answer from the cell computer in said processing target state, converting generated new information into an output form corresponding to a question and outputting converted output as an answer.

10. In an information generating method according to claim

9, an information generating method characterized in that:

said central management computer including:

a step for analyzing a condition of an inputted question by a request condition analyzing unit when a question is inputted to a question input unit;

a step for transmitting said request condition to all cell computers by a request condition processing target cell detecting unit based on said analyzed request condition, receiving an answer indicative of the unsuitable state from an unsuitable cell computer and detecting a cell computer, which becomes a processing target in response to the request condition, from said all cell computers excepting said unsuitable cell computer;

a process for continuing to effect the later retrieving operation on said detected processing target cell computer by a retrieval transmitting and receiving unit to receive a retrieval answer from said processing target cell computer;

a step for analyzing the retrieved result by a retrieved result analyzing unit based on said received detected retrieval answer;

a step for understanding meaning and generating information from said analyzed result by the semantic understanding/information generating unit;

a step for converting said generated new information into a requested output form by the output information converting

unit;

a step for storing an address of a connection destination cell computer having a semantic connection based on said generated new information such that said address can be updated sequentially; and

a step for outputting said generated new information in the requested output form by the answer output unit.

11. In an information generation method according to claim 9, an information generation method characterized in that:

said plurality of cell computers includes:

a step in which it is determined at a request condition processing target judging unit by using judgment information indicative of presence or absence of a connection destination cell computer in response to request conditions simultaneously transmitted from said central management computer to all cell computers whether or not its own cell computer becomes a processing target;

a step in which an unsuitable state is returned to said central management computer if its own cell computer is unsuitable for said request condition and in which the processing target state is transmitted to the connection destination cell computer by the unsuitable reply/connection destination communicating unit if its own cell computer becomes a processing target for said request condition;

a step for receiving retrieval information from said central management computer by a retrieval receiving portion if its own cell computer become a processing target relative to said request condition;

a step for retrieving other connection destination cell computer which its own cell computer has an information connection in response to said request condition and in which it is determined at a connection destination judging unit by using information of said connection destination cell computer whether or not said retrieval based on said retrieval information can be executed for every said request condition;

a step for returning said retrieval answer to said central management computer by a retrieval answer unit;

a step for storing said retrieval information and a knowledge obtained based on an answer of a retrieval in a knowledge memory unit such that they can be updated sequentially; and

a step for storing a connection destination cell computer corresponding to said obtained knowledge in a connection destination cell memory unit such that it can be updated sequentially.

12. In an information generating method according to claim 11, an information generating method characterized in that:

said decision step of said connection destination judging

unit includes:

a step for determining whether or not there is a connection destination cell computer at a node number N including its own cell computer in an operation for searching a path having a step number N (natural number) in a connection decision having a request condition structure;

a step for determining based on information indicative of the fact that there is a connection destination cell computer at a node number N that cell computer including its own cell computer having said node number N are placed in the processing target state and in which information is transmitted through said unsuitable reply/connection destination cell communicating unit to said central management computer such that these cell computers are to be moved to the processing target state; and

a step in which it is determined based on information indicative of the fact that there is no connection destination cell computer at said node number N that cell computer including its own cell computer having other node number are placed in the unsuitable state, information is transmitted through said unsuitable reply/connection destination cell communicating unit to said central management computer such that these cell computers are to be moved to the unsuitable state and in which information indicative of said unsuitable state is transmitted to said central management computer.

13. In an information generating method according to claim 11, an information generating method characterized in that:

said decision step of said connection destination judging unit includes:

a step in which when a tree-like path including its own cell computer is retrieved in the operation for retrieving a tree-like path in a connection decision based on a request condition structure, it is determined whether or not a tree-like connection destination cell computer including its own cell computer is placed at the end, it is sequentially determined that cell computers at the end are placed at the end so that it is determined that all of tree-like connection destination cell computer are placed at the end;

a step in which it is determined based on information indicative of the fact that all tree-like connection destination cell computer are placed at the end that cell computers at the end are placed in the processing target state so that it is determined that all tree-like connection destination cell computers are placed at the processing target state and that information is transmitted through said unsuitable reply/connection destination cell communicating unit to said central management computer such that these cell computers are to be moved to the processing target state; and

a step in which it is determined that all remaining loop-like connection destination cell computers except tree-like

connection destination cell computers in the processing target state are placed in the unsuitable state so that information is transmitted through said unsuitable reply/connection destination cell communicating unit to said central management computer such that these computers are to be moved to the unsuitable state and that information indicative of the unsuitable state is transmitted to said central management computer.

14. In an information generating method according to claim 11, an information generating method characterized in that:

said decision step of said connection destination judging unit includes:

a step in which when loop-like connection destination cell computer including its own cell computer are retrieved in the operation for retrieving a loop-like path in the connection decision based on the request condition structure, it is determined whether or not tree-like connection destination cell computers including its own cell computer are placed at the end, it is determined that connection destination cell computers at the end also are not belonging to a loop so that it is determined that all tree-like connection destination cell computers also are not belonging to the loop;

a step in which it is determined based on information indicative of the fact that all tree-like connection destination cell computers are placed at the end that cell computers at the

end are placed in the unsuitable state so that it is determined that all tree-like connection destination cell computer are placed in the unsuitable state, information is transmitted through said unsuitable reply/connection destination cell communicating unit to said central management computer such that these cell computers are to be moved to the unsuitable state and in which information indicative of the unsuitable state is transmitted to said central management computer;

a step for determining whether or not there is a cell computer including its own cell computer at a node number N (natural number);

a step in which tree-like connection destination cell computer in the unsuitable state are removed, it is determined by further decision of the node number N that remaining loop-like connection destination cell computer having the node number N are placed at the processing target state and information is transmitted through said unsuitable reply/connection destination cell communicating unit to said central management computer so that these cell computers are to be moved to the processing target state; and

a step in which it is determined based on information indicative of the fact that there is no connection destination cell computer at the node number N that cell computers including its own cell computer having other node number are placed in the unsuitable state so that information is transmitted through said

unsuitable reply/connection destination cell communicating unit to said central management computer such that these cell computers are to be moved to the unsuitable state and that information indicative of the unsuitable state is transmitted to said central management computer and adjacent cell computers.